

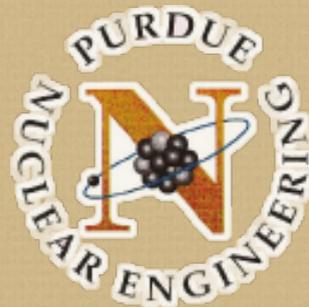
PURDUE UNIVERSITY THERMAL HYDRAULIC EXPERIMENT FACILITY

- LWR & SMR GROUP -

by

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LABORATORY CAPABILITY

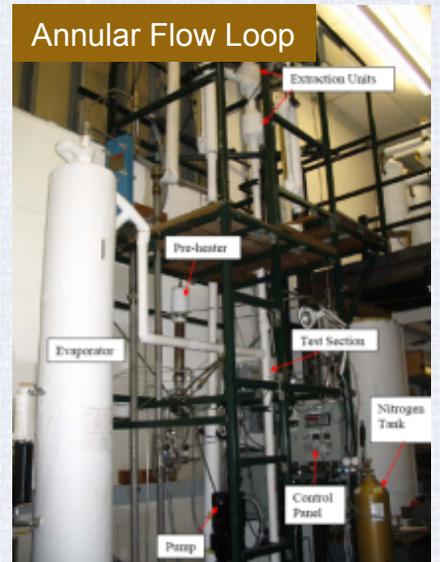
I. *Fundamental Physics of Thermal-Hydraulics*

- **12", 8", 6", 4", 2" & 1" ID Two-phase Flow Pipe Loops**
 - Objective of Facility
 - To acquire 3-D two-phase flow data for code development
 - Dimension & Capability
 - Height: up to 20 feet
 - Orientation: vertical up, down, horizontal
 - Previous Work
 - Department of Energy (DOE)
 - Nuclear Regulatory Commission (NRC)
 - Bettis Atomic Power Laboratory
 - Future Planned Work
 - DOE/NRC
- **Annular, Droplet, Entrainment and Film Dynamics Facility**
 - Objective of Facility
 - To simulate annular two-phase flow dynamics in the BWR
 - Dimension & Capability
 - Pressure: up to 10 bar
 - Working Fluid: air-water and Freon 113
 - Gas velocity up to 100 m/s
 - Previous Work
 - Tokyo Electric Power Company (TEPCO)
 - Future Planned Work
 - DOE

Small Diameter Pipe Loop



Annular Flow Loop



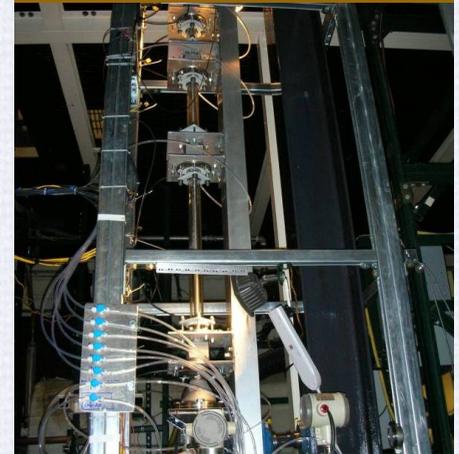


LABORATORY CAPABILITY

I. *Fundamental Physics of Thermal-Hydraulics*

- **Boiling Loop for Seismic Effect Study**
 - Objective of Facility
 - To acquire 3-D Boiling data for earthquake analysis
 - Dimension & Capability
 - Pressure: up to 10 bar
 - Geometry: annulus
 - Previous Work
 - TEPCO
 - Future Planned Work
 - DOE/NRC
- **High Pressure Boiling Loop up to Critical Heat Flux**
 - Objective of Facility
 - To measure wall nucleation characteristics
 - To study 3-D wall nucleation behavior
 - Dimension & Capability
 - Pressure: up to 10 bar
 - Geometry: annulus
 - Previous Work
 - NRC
 - Bettis Atomic Power Laboratory
 - Future Planned Work
 - Bettis Atomic Power Laboratory

Seismic Vibration Simulation Loop



Boiling & Condensation Loop



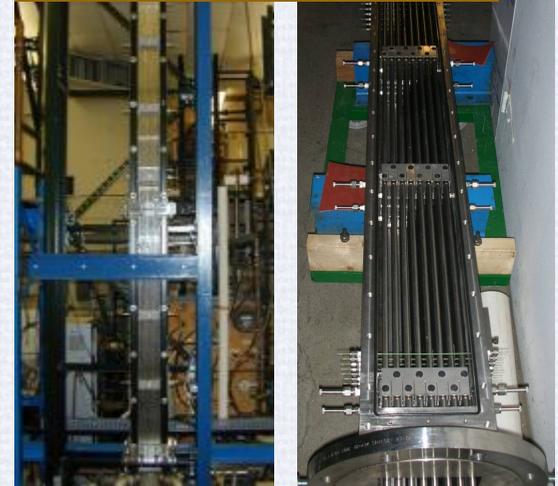


LABORATORY CAPABILITY

II. Separate-effects Tests for Reactor Safety

- **Two-phase Flow in Rod Bundle**
 - Objective of Facility
 - To acquire 3-D local parameters in rod bundle
 - To analyze the spacer-grid effects
 - Dimension & Capability
 - Pressure: up to 10 bar
 - Geometry: full size BWR 8x8 bundle
 - Previous Work
 - NRC
 - Future Planned Work
 - DOE/NRC
- **BWR-Type Novel Modular Reactor (NMR-50) Test Facility**
 - Objective of Facility
 - To study the natural circulation start-up instability
 - Dimension & Capability
 - Pressure: up to 10 bar
 - Max Power: 18 kW to simulate fission coupling
 - Height: up to 7 meters (or 23 feet)
 - Previous Work
 - DOE
 - Future Planned Work
 - DOE

Nuclear Reactor Fuel Assembly Simulation Loop



Natural Circulation SMR Loop





LABORATORY CAPABILITY

II. Separate-effects Tests for Reactor Safety

- **PWR-Type Small Modular Reactor (Similar to NuScale) Test Facility**
 - Objective of Facility
 - To study the blowdown accident transient and design basis accident
 - To study the ECCS performance
 - Dimension & Capability
 - Pressure: up to 10 bar
 - Max Power: 18 kW
 - Height: up to 12 feet
 - Previous Work
 - DOE
 - Future Planned Work
 - DOE





LABORATORY CAPABILITY

III. Integral Test Facility PUMA

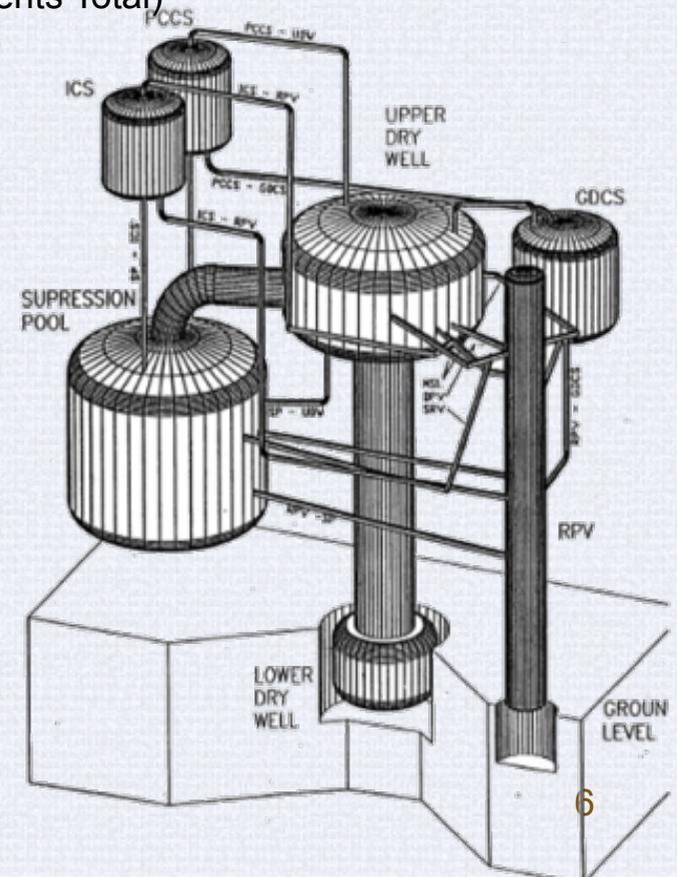
Purdue University Multi-Dimensional Test Assembly (PUMA) Test Facility Features

- Well-Scaled Integral Test Facility for SBWR/ESBWR Certification
- Maximum Heater Rod Power of 650 kW
- State-of-Art Measurement and Control System (500 Instruments Total)

Possible User Facility

- Need Permission from NRC
- Requires 3 Research Assistants for operation and service

PUMA Facility (Top View)





LABORATORY CAPABILITY

IV. Computational Calculation Capability

System Analysis Codes

TRAC P, B, M, RELAP5, TRACE, CATHARE, RAMONA

CFD Codes

CFX, FLUENT

CFD Code Development

Cooperate with Bettis and ANSYS for the development of 3-D boiling CFX code

Computer Hardware Available at TRSL

- About 35 personal computers in total
- 5 of the computers connected to the network for general usage purposes
- 20 computers used for acquisition of data from thermal-hydraulic and integral test facilities
- 2 computers for CFD codes
- 5~8 computers used by PUMA staff for system analysis codes and data analysis of PUMA experiments
- 1 Unix workstation for system analysis codes



Bubble Plume

<http://www.isma.fr/images/fuchs/clean-solution/wbl-1.jpg>

